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STUDIES ON GENERIC DELIMITATIONS ON THE FOUR GENERA *ROTALA* *AMMANNIA*, *NESAEA* AND *HIONANTHERA* (LYTHRACEAE)— A HISTORICAL SURVEY

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ABSTRACT

A taxonomic resume of the generic concepts involved in *Rotala* L., *Ammannia* [Houst.] L., *Nesaea* Comm. ex Kunth and *Hionanthera* Fernandes & Diniz, from the time of Linnaeus (1753) to Cook *et al.* (1974) and detailed descriptions of the four genera, based on gross external morphology and their geographical range, are presented and discussed. The nomenclature and distribution of 30 species undertaken for biosystematic studies are provided. A comprehensive key synthesising characters derived from such multi-directional evidence, is formulated for more rational delimitation of the four genera.

INTRODUCTION

In 1737, Linnaeus described the genus *Ammannia*, attributing its authority to Houston, but only in 1753 he assigned to it three species, *viz*. *A. latifolia* from the Caribbean, *A. ramosior* from Virginia and *A. baccifera* from China. Of these, *A. latifolia* L. has been selected as the lectotype species of the genus (Britton & Brown 1913). Subsequently, Linnaeus (1771) described *Rotala*, typified by *R. verticillaris* L., based on specimens from "India Orientalis" and Kunth (1824) described *Nesaea* Comm. based on *Lythrum triflorum* Linn.f. presumably from Mauritius (not from America as stated by Linn. f.). Earlier, Jussieu (1789, 1791) had cited *Nesaea* Comm. only as a synonym under *Lythrum triflorum* L. f.

Between 1764 and 1866, 21 additional genera were recognised within the family Lythraceae, 14 of which (either wholly or in part) are shown as congeneric with *Rotala* L., 6 (either wholly or in part), with *Ammannia* (Houst.) Linn. and only 2 with *Nesaea* Comm. ex Kunth. These genera, together with references to their places of publication, names of type species and the types on which the type-species are based, are shown under the genera *Rotala* L., *Ammannia* (Houst.) L. and *Nesaea* Comm. ex Kunth in a tabular form, (Table I) to bring out the historical sequence in which they were recognised. After 1866, it appears, there have been efforts to highlight the similarities, rather than the differences between them, until Fernandes & Diniz (1955) established the genus *Hionanthera* typified by *H. mossambicensis* based on plants from Mozambique in Africa.

REVIEW OF THE GENERIC CONCEPTS IN THE TRIBES AMMANNIEAE AND LYTHREAE

De Candolle (1828) recognised *Rotala* L. (with 2 spp.). *Cryptotheca* Bl (with 2 spp.), *Suffrenia* Bellard. (with 1 sp.), *Ameletia* DC. (with 1 sp.) and *Ammannia* L. (with 27 spp.); he grouped the species of *Ameletia* into four sections, the fourth section having 4-7 petals, and stamens twice the number of petals. It comprised four species and was named by him 'Dyplostemoneae'.

In their treatment of the tribe Lythreae in Peninsular India, Wight & Arnott (1834) recognised the genera *Rotala* L., *Ameletia* DC., *Nesaea* Comm. ex Kunth and *Ammannia* L., the first three represented by one species each and the last one by 10

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spp. They, however, divided the genus *Ammannia* L. into 5 sub-genera by raising the rank of Dyplostemoneae DC. from section to the subgenus *Diplostemon* (DC.) Wt. & Arn. and by recognising *Tritheca, Ditheca* and *Hapalocarpum* and *Mirkooa* as new subgenera and stated, "this genus ought either to be divided into genera or into sections on a different principle from that adopted by authors. The genus or subgenus with 4 stamens, a 4-celled ovary and accessory teeth to the calyx which ought to be viewed as the type of *Ammannia,* does not occur in India. Our first subgenus (*Diplostemon*) ought perhaps to be removed to *Nesaea* from which it differs only by the bracteoles at the base of the calyx". However, Wight & Arnott (l.c.) virtually lecto-typified the subg. *Diplostemon* (DC.) Wt. & Arn. by *Ammannia octandra* L. which was one of the four species included in the section Dyplostemoneae by De Candolle (1828).

Wight (1840), however, revised the earlier (1834) treatment, redefined the four genera by merging the pentandrous species of *Ammannia,* (viz. *A. pentandra* Roxb.) in *Rotala* L. and the genera *Mirkooa* (represented by *A. rotundifolia* Roxb.) and *Nimmonia* Wt. & Arn. (represented by *N. floribunda* Wt.) in the genus *Ameletia* DC. and by suggesting that the four species of *Ammannia* included by DC. (1828) in the section Dyplostemoneae should be transferred to *Nesaea.* He included in *Ameletia* four spp., *Ameletia indica* DC., *A. floribunda* (Wt.) Wt., *A. tenuis* (Wt.) Wt., and *A. rotundifolia* (Roxb.) Wt., on the ground that they shared the septifrugal capsule with *Rotala* L. but the 4-cleft calyx without accessory teeth, petals 4, stamens 4, and 2-4-celled ovary with *Ammannia.* Yet, unlike either *Rotala* or *Ammannia,* they possessed flowers in bracteated spikes and the calyx 2-bracteolate. In re-defining *Nesaea* by including certain species, which in 1834 he had treated as *Ammannia,* Wight (1840) considered the bracteal appendages of secondary value and emphasised that species of *Nesaea* must have "twice as many stamens as lobes of the calyx and half the number of cells to the ovary that it has petals".

Miquel (1855), in partial agreement with Wight & Arnott (1834) and Wight (1840), recognised not only *Rotala* L. and *Ameletia* DC. as distinct genera, but made a new combination, *Suffrenia dichotoma* (Bl.) Miquel based on *Cryptotheca dichotoma* Bl. He raised four subgenera, *Diplostemon* (DC.) Wt. & Arn., *Tritheca* Wt. & Arn., *Ditheca* Wt. & Arn., and *Hapalocarpum* Wt. & Arn., to generic rank and described a monotypic genus *Ammanella* typified by *A. linearis* Miq. from Java. He treated *Ammannia microcarpa* DC. as conspecific with *Suffrenia dichotoma* (Bl.) Miq. In recognising *Hapalocarpum* as a genus, Miquel (l.c.) transferred only two of the 4 species included under the subgenus *Hapalocarpum* by Wight & Arnott viz. *H. vesicatorium* (Roxb.) Miq. based on *Ammannia vesicatoria* Roxb. and *H. indicum* (Lam.) Miq. based on *A. indica* Lam. Of the other two species, he treated *A. multiflora* Roxb. as conspecific with *Suffrenia dichotoma* as stated above, but made no comment on *Ammannia glauca* (Wall.) Koehne. It is of interest to note that Lamarck referred Burm. Fl. Ind. t. 65, f. 3 (1768) to *A. indica* Lam., although Burmann himself had included the reference to this figure under *A. baccifera* L.

Bentham & Hooker fil. (1867), who recognised two tribes, Ammanieae and Lythreae, within the Lythraceae, included *Ammannia* L., *Hydrolythrum* Hook. f., and *Quartinia* Endl. in the former and *Nesaea* Comm. ex Kunth, in the latter. They distinguished the genera as follows (translated):

Calyx 3-5-dentate, stamens 2-8, filaments filiform, herbs growing in marshes, leaves opposite ... *Ammannia*
Calyx 4-lobed, petals 4, stamens 4, hypogynous, glands 8, plants submerged in water, leaves verticillate ... *Hydrolythrum*

Calyx 4-dentate, petals 0, stamens 4, plants submerged in water, leaves fascicled and capillary ...	*Quartinia*
Calyx 8-14 dentate, teeth alternate and minute, petals 4-7, stamens 8-14, capsule 3-6 locular; herbs or woody ...	*Nesaea*

Within the genus *Ammannia,* Bentham & Hooker f. grouped the species into two sections which they considered natural. Section 1, with flowers sessile and solitary and capsule valves dehiscent, included the species referred to *Rotala* L., *Amelètia* DC., *Nimmonia* Wight, *Suffrenia* Bellardi, *Sellowia* Roth ex R. & S. and *Winterlia* Spreng.; these are all now universally considered as synonyms of *Rotala.* Section 2 contained species with flowers pedicellate, solitary or cymose and capsules irregularly or transversely dehiscent i.e. species referred to *Cryptotheca* Bl. and the tribe Ammannieae sensu Blume (1828). They excluded *Rotala mexicana* Cham & Schl. from *Ammannia,* suspecting it as a possible member of the Caryophyllaceae, and treated *Rhyacophila* Hochst. (1841) as a synonym of *Quartinia* Endl. (1842), presumably considering the former as a later homonym of *Rhuacophyla* Bl. (1827), the latter a genus of the family Liliaceae. Further, they recognised three subgenera in *Nesaea,* viz. *Decodon* (Gmel.) Benth. & Hook. f., *Heimia* (Link) Benth. & Hook. f. and *Nesaea,* the third subgenus consisting of species endemic in Africa and Madagascar and having peduncles 3-many flowered, flowers 2-bracteate at base and pedicel 2-bracteolate in the middle.

Clarke (1879) treated the two sections of Bentham and Hooker f. within *Ammannia* as subgenera; (which he also considered natural) : the subgenus *Rotala* (L.) Clarke and the subgenus *Eu-ammannia* Clarke, and followed Bentham & Hooker fil. (1867) in maintaining *Hydrolythrum* and *Nesaea* as distinct genera.

Baillon (1877) recognised three series in the family Lythraceae, the series *Salicariees, Crypteroniees* and *Ammaniees* and referred the genus *Nesaea* Comm. ex Kunth to the first series and the other two genera *Rotala* L. and *Ammannia* L. to the third one.

Hiern (1871), in partial agreement with Bentham & Hooker fil. (1867), recognised the genera *Rhyacophila* Hochst. (= *Quartinia* Endl.) and *Nesaea* Comm. ex Kunth as distinct, but considered *Rotala* L. and *Ammannia* (Houst.) Linn. also as good genera. Further, his 'key' for diagnosing these genera brought *Rotala* and *Rhyacophila* (with flowers sessile or subsessile in the former and racemose flowers in the latter) as more closely allied and *Ammannia* and *Nesaea* (both with cymose or capitate flowers) as closer to each other, and he treated *Quartinia turfosa* Rich. (1842) as conspecific with *Rhyacophila repens* Hochst. (1841).

Koehne (1880, 1903), who monographed the family Lythraceae, merged *Rhycophila* Hochst. and 13 other generic names proposed after 1771 as congeneric and synonymous with *Rotala* L., 6 genera proposed after 1753 as congeneric and synonymous with *Ammannia* L. and 2 others with *Nesaea* Comm. ex Kunth (Table 2). He, however, recognised sections, subsections and series in *Rotala* and in *Nesaea* and two sub-genera: subg. *Eu-ammannia* (Clarke) and subg. *Cryptotheca* (Bl.) Koehne, as well as sections, subsections and series in *Ammannia,* these based on the genera which Koehne treated as synonyms. The subgeneric categories often were named after the genera which he reduced from the generic rank. While Koehne assigned 19 spp. to the subgenus *Eu-ammannia* (Clarke) Koehne, the subgenus *Cryptotheca* (Bl.) Koehne consisted of only one species, *Ammannia microcarpa* DC. with *C. dichotoma* Bl. treated as a synonym. This latter treatment is questionable because De Candolle (1828) included *A. microcarpa* DC. and *C. dichotoma* Bl. in two different genera. *A. microcarpa* DC. with petals 0, stamens 4, capsule obovoid hardly justifies its inclusion within the subgenus *Cryptotheca,* which Koehne himself characterised as having petals 4, stamens 2, opposite, parietal placentation and capsule ellipsoid and attenuated.

Gin (1909) followed Koehne (1903) in assigning the genera *Rotala, Ammannia* and *Nesaea* to the various sections and series recognised by the latter within the family Lythraceae.

In agreement with Koehne's (1903) system, Blatter & Hallberg (1918) and Gamble (1919) recognised three genera in the Indian region, viz. *Rotala, Ammannia* and *Nesaea,* which they distinguish mainly on the nature of dehiscence of the capsule.

Britton & Brown (1913) who lectotypified *Ammannia* L. by naming *A. latifolia* L as the type species, followed Koehne by distinguishing it from *Rotala* mainly by the dehiscence of the capsule. Hutchinson and Dalziel (1927) followed Koehne (1903) in treating *Rotala* L., *Ammannia* L. and *Nesaea* Comm. ex Kunth as three genera in Africa, but disagreed with him in considering the relative length of the style as of diagnostic value in recognising Sections *Eu-stylia* and *Astylia* within subgenus *Eu-ammannia.* They considered *A. senegalensis* Lam. as a very variable species of which they considered *A. auriculata* Willd., *A. prieureana* Guill. et Perr. and *A. multiflora* Roxb. with its var. *floribunda* Koehne as synonyms. They laid emphasis on the cymes being pedunculate or sessile, stems slender or thick and spongy and angled or not, on the size and shape of the leaves, and the presence or absence of appendages of the calyx-lobes etc.

Keay (1954), who recognised the three genera, followed Hiern (1871) in preference to Koehne (1903) in grouping *Nesaea* and *Ammannia* together because both were characterised by "Flowers in cymes or umbels or crowded into bracteate heads" as opposed to *Rotala* L. having "flowers solitary or subsolitary, sessile or sub-sessile in leaf-axils, fruit a septicidal capsule". But he disagreed with Hutchinson & Dalziel's (1927) criticism of Koehne's using the relative length of the style as of diagnostic value in *Ammannia* L. and treated *A. auriculata* Willd. and *A. prieureana* Guill. et Perr. with styles more than 0.3 mm as distinct from *A. senegalensis* Lam. with styles very short and not up to 0.3 mm long.

Graham (1964) considered the recognition of tribes in the family on the basis of the septa of the ovary (cf. Koehne, 1903), as a variable character and difficult to ascertain in many specimens. She therefore proposed a key for distinguishing *Rotala* from *Ammannia* in southeastern United States only as follows:

Middle and upper leaves attenuate at base; capsule dehiscing septicidally, the outer wall of the capsule finely and densely striate; flowers solitary and axillary ... *Rotala*

Middle and upper leaves cordate to auriculate at base, capsule dehiscing irregularly, the outer wall of the capsule smooth, not striate; flowers (1-)3-to many, axillary ... *Ammannia*

Webb (1968) distinguished *Rotala,* characterised by "flowers solitary or in pairs in the leaf-axils, epicalyx absent" from *Ammannia* characterised by flowers at least in lower part of plant, "in cymes or clusters of 3 or more in each leaf-axil, petals, if present, not more than 2.5 mm long, leaves opposite". He used the relative length of the styles (2-3 mm vs. 0.5 mm or less) for distinguishing species groups within *Ammannia.*

Leeuwen (1974) emphasized the nature of the dehiscence of the capsule for distinguishing *Rotala* from *Ammannia* but also pointed to a distinct anatomical difference in the structure of the pericarp which in both the genera consists of two main layers of parenchymatous cells, the inner of which is slightly more lignified than the outer one. In *Rotala,* the cells of the inner layers are almost linear, strongly lignified and with fine transverse lines when viewed microscopically, and easily separated from the outer layer. In *Ammannia,* the cells of both the layers are similar in shape, although the cells of the inner layer are more lignified. Rajagopal & Ramaya (1969) transferred *Ammannia pygmaea* Kurz to *Rotala* L. because its capsule possesses the transverse striations characteristic of *Rotala* L. (Plate I-2). Considering the merousness of the flowers as variable from species to species, often even on one plant, Leeuwen (1974), in agreement with Koehne (1903), treated *Rotala densiflora* Roth ex R. & S. with 4 stamens as conspecific with *Sellowia uliginosa* Roth ex R. & S. with 5 stamens. Leeuwen therefore used the number of calyx lobes, petals and stamens, arrangement of leaves, presence or absence of style, insertion of stamens on the calyx tube, presence or absence of the appendages between the calyx lobes, colour and presence of the bracteoles and number of valves of the fruit for distinguishing species of *Rotala* in Malesia.

As stated at the outset, Fernandes & Diniz (1955, 1957, 1959) in their treatment of the African Lythraceae established *Hionanthera* typified by *H. mossambicensis* as a genus intermediate between *Rotala* and *Ammannia* and described four species. Although they provide no key for distinguishing the new genus from *Rotala, Ammannia* and *Nesaea,* their descriptions and illustrations suggest that, like *Rotala,* the flowers of *Hionanthera* are 3-4-5 merous, petals present, showy and persistent, stamens 3-4-5 in number, style and the nectary glands present but, as in *Ammannia,* its flowers are in axillary glomerules and capsule irregularly dehiscent from the top, not septicidally as in *Rotala.* Yet, the four species of *Hionanthera* are distinctive in that they possess conduplicate or canaliculate, decussate, sessile, linear leaves, crumpled petals, capsules dehiscing only irregularly half-way from the top, ovary only incompletely 2-locular and seeds 2-5 per capsule and largest in size for the group. The authors also describe a number of new species under the genera *Rotala* and *Nesaea* from Africa.

Raynal (1967) excluded *Rotala filiformis* (Bellardi) Hiren, from the genus *Rotala* and *R. filiformis* sensu Hiern (1871) as conspecific partly with *R. capensis* (Harvey) A. Fernandes & Diniz and partly with *R. heterophylla* Welw. ex Fernandes & Diniz and proposed a key to the recognition of 13 species of *Rotala* in Central and east Africa.

Cook *et al.* (1974) propose two alternate keys for the recognition of the three genera, *Rotala, Ammannia* and *Nesaea,* merge the genus *Hionanthera* as congeneric with *Ammannia* and, considering the generic delimitations as problematical, recommend revision of the family Lythraceae.

Tables 1 and 2 summarize the history of this taxonomic survey and the different generic concepts discussed above.

TABLE I

Conspectus of the genera from 1753 *to* 1955

Sl. No.	Year	Author	Names of genera	Type species	Type locality	Genera recognised
1	1753	Linnaeus	Ammannia [Houst.]	*A. latifolia* L. (Lectotype sp. see Britton & Brown, 1913)	Caribbean	*Ammannia* L.
2	1764	Arduino	Cornelia	*C. verticillata* Ard.	'Venetian Region'	*Ammannia* L.
3	1771	Linnaeus	Rotala	*R. verticillaris* L.	'India Orientalis'	*Rotala* L.
4	1824	Kunth	Nesaea Comm.	*N. triflora* (L. f.) Kunth (based on *Lythrum triflorum* L. f.)	Mauritius	*Nesaea* Comm. ex Kunth

Sl. No.	Year	Author	Name of genera	Type species	Type locality	Genera recognised
5	1794	Bellardi	Suffrenia	*S. filiformis* Bellardi	Italy, Vercelli	excluded from *Rotala* L.
6	1817	Rafinesque	Boykinia	*B. humilis* Raf.	North America	*Rotala* L.
7	1819	Roemer et Schult	Sellowia Roth	*S. uliginosa* ex Roem. & Schult.	'India Orientalis'	*Rotala* L.
8	1825	Sprengel	Winterlia	*W. uliginosa* (Roth ex Roem. & Schult.) Spreng. (based on *S. uliginosa* Roth ex Roem. & Schult.)	-do-	*Rotala* L.
9	1826	De Candolle	Ameletia	*A. indica* (Willd.) DC. (based on *Peplis indica* Willd.)	-do-	*Rotala* L.
10	1826	Blume	Cryptotheca	*C. dichotoma* Bl. (selected as the type (lectotype) of subg. *Cryptotheca* by Koehne 1903)	Java	*Ammannia* L.
11	1828	De Candolle	Trotula Comm.	Based on *Lythrum triflorum* L.f.	Name in synon.	*Nesaea* Comm. ex Kunth
12	1828	-do-	Ortegioides Soland.	*O. decussata* Soland. ex DC.	-do-	*Rotala* L.
13	1836	Refinesque	Nexilis	*N. indica* (Willd.) Raf. (based on *Peplis indica* Willd.)	'India Orientalis'	*Rotala* L.
14	1837	Wight	Nimmonia	*N. floribunda* Wight		*Rotala* L.
15	1841	Hochst.	Rhyacophila	*R. repens* Hochst.	Abyssinia	*Rotala* L.
16	1842	Endlicher	Quartinia	Based on *Rhyacophila repens* Hochst.	Name superfluous for *Rhyacophila* Hochst. *non Rhuacophila* Blume	*Rotala* L.
17	1843	Hooker f.	Hydrolythrum	*H. wallichii* Hook. f.	Burma, Tavoy	*Rotala* L.
18	1843	E. Mey	Tolypeuma	*nomen nudum*		*Nesaea* Comm. ex Kunth
19	1855	Miquel	Ammanella	*A. linearis* Miq.	Java	*Ammannia* L.
20	1855	-do-	Ditheca (Wt. & Arn.)	*D. debilis* (Ait.) Miq. *D. densiflora* (Roth ex Roem. & Schult.) Miq. etc. (Type species not indicated)		*Ammannia* L. & *Rotala* L.
21	1855	-do-	Diplostemon (DC.)	*D. octandrum* (L. f.) Miq. (based on *Ammannia octandra* L.f.)	'India Orientalis'	*Ammannia* L.
22	1855	-do-	Tritheca (Wt. & Arn.)	*T. pentandra* (Roxb.) Miq. (based on *Ammannia pentandra* Roxb.)	Ex India, native of moist places (? Bengal)	*Rotala* L.
23	1855	-do-	Hapalocarpum (Wt. & Arn.)	*H. vesicatorium* (Roxb.) Miq. (based on *Ammannia vesicatoria* Roxb.)	Ex India, (? Bengal)	*Ammannia* L.
24	1866	Bentham	Hypobrichia	*H. spruceana* Benth.	Cuba	*Rotala* L.
25	1955	Fernandes & Diniz	Hionanthera	*H. mossambicensis* Fernandes & Diniz	Africa, Mozambique	*Hionanthera* Fernandes et Diniz.

TABLE 2

Review of the generic concepts

Authority	Area	Treatment
De Candolle, A.P. 1828	World	recognised the genera: (1) *Rotala* L. (2 spp.), (*a*) *Cryptotheca* Bl. (2 spp.), (3) *Suffrenia* Bellardi (1 sp.), (4) *Ameletia* DC. (1 sp.), (5) *Ammannia* L. (27 spp.), in 4 sections including *Diplostemoneae* with 4 spp.
Wight, R. & Arnott 1834	India	recognised the genera: (1) *Rotala* L. (1 sp.), (2) *Ameletia* DC. (1 sp.), (3) *Nesaea* Comm. ex Kunth (1 sp.), (4) *Ammannia* L. (10 spp.) with 5 sub-genera including *Diplostemon* (DC.) Wt. & Arn.
Wight, R. 1837	India	proposed the genus *Nimmonia* Wt. based on *N. floribunda* Wt. from Madras.
Wight, R. 1840	India	(1) transferred *Ammannia pentandra* Roxb. to *Rotala* L., (2) merged genus *Mirkooa* and *Nimmonia* Wt. in *Ameletia* DC. comprising 4 spp. viz. *A. octandra* L.f., *A tenuis* Wt., *A. rotundifolia* Wt., *Nimmonia floribunda* Wt., (3) laid emphasis on the number of stamens and cells in the ovary for species recognition in *Nesaea* and transferred whole of section *Diplostemoneae* DC. to *Nesaea*.
Miquel 1855	Indonesia & India	recognised the genera: (1) *Rotala* L., (2) *Ameletia* DC., (3) *Suffrenia dichotoma* (Bl.) Miq., (4) *Diplostemon* (DC.) Miq., (5) *Tritheca* (Wt.) Miq., (6) *Ditheca* (Wt.) Miq., (7) *Hapalocarpum* (Wt.) Miq. with 2 spp., (8) *Ammanella* Miq.
Bentham & Hooker fil. 1867		(1) recognised two tribes: *Ammannieae* comprising *Ammannia* L., *Hydrolythrum* Hook. f. and *Quartinia* Endl. and Lythreae with *Nesaea* Comm. ex Kunth, (2) grouped the spp. into two sections within the genus *Ammannia*, (3) recognised in *Nesaea* 3 subgenera (*i*) *Heimia*, (*ii*) *Diplosodon* and (*iii*) *Nesaea*.
Hiern 1871	Africa	recognised the genera: (1) *Rhyocophila* Hochst., (2) *Nesaea* Comm. ex Kunth (3) *Rotala* L., (4) *Ammannia* L.
Baillon, H. 1877		recognised three large groups or series: (1) Salicariees, (2) Crypteroniees, (3) Ammanniees in the *Lythraceae*; assigned *Nesaea* to the first and *Ammannia* and *Rotala* to the third one.
Clarke, C.B. 1879	India	raised Bentham & Hooker's two sections within *Ammannia* as subgenera, namely *Rotala* (L.) Clarke and *Eu-ammannia* Clarke.
Koehne 1880 1903 1907 1909	World	(1) treated *Ryacophylla* Hochst. and *Suffrenia* Bellardi and 11 other generic names as congeneric and synonymous with *Rotala* L., (2) treated 6 genera as congeneric and synonymous to *Ammannia* L., (3) considered *Nesaea* Comm. ex Kunth. as a genus of a natural group of ± 50 spp., (4) recognised 2 subgenera in *Ammannia*.
Blatter & Hallberg 1918	India	followed Koehne in assigning the species of the Indian region.
Gamble 1919	S. India	
Hutchinson & Dalziel 1927	Africa	followed Koehne in recognising the three genera for species occurring in Africa; considered *A. senegalensis* as a very variable species with which *A. auriculata* Willd., *A. prieureana* Guill. & Perr. and *A. multiflora* var. *floribunda* Koehne as synonymous and conspecific.
Keay 1954	Africa	recognised the three genera *Rotala* L., *Ammannia* L. and *Nesaea* Kunth as delimited by Koehne but grouped *Ammannia* and *Nesaea* together in one tribe on the basis of their bearing cymes or umbels of flowers and removed *Rotala* L. with solitary or sub-solitary flowers to another tribe. He, however, agreed with Koehne's idea of using the relative lengths of the style as one of diagnostic value in *Ammannia* L.

Authority	Area	Treatment
Fernandes & Diniz 1955 1957 1959	Africa	founded the genus *Hionanthera* typified by *H. mossambicensis* Fernandes & Diniz and described 3 other spp. under this genus and a number of new species under *Rotala* and *Ammannia*.
Graham 1964	America	considered recognition of genera in this alliance on the basis of complete or incomplete septa in the ovary as difficult for practical recognition and variable; proposed a key for distinguishing *Rotala* from *Ammannia* on the shape of the middle and upper leaves, nature of dehiscence of the capsule, nature of the capsule wall and arrangement of the flowers in the leaf-axils.
Webb 1968	Europe	distinguished *Rotala* from *Ammannia* on the basis of number of flowers in leaf axils and used the relative length of the style for distinguishing species groups within *Ammannia*.
Rajagopal & Ramaya 1969	India	transferred *Ammannia* (*Rotala*) *pygmaea* Kurz to *Rotala* L. on the basis of transverse striations on the capsule wall characteristic of the genus *Rotala* L.
Leeuwen 1974	Malesia	gave emphasis on the nature of dehiscence of the capsule and on presence of transverse striations on the pericarp to distinguish species of *Rotala* from those of *Ammannia*; treated *R. pentandra* (Roxb.) Koehne and *R. leptopetala* (Bl.) Koehne as conspecific and *R. densiflora* with four stamens (as conspecific with *Sellowia uliginosa* having 5 stamens.
Raynal 1967	Africa	Excluded *Rotala filiformis* (Bellardi) Hiern from the genus *Rotala* and proposed a key for recognition of 13 species of *Rotala* from Africa.
Cook *et al* 1974	World (aquatic spp. only).	treated *Hionanthera* as probably congeneric with *Ammannio*, proposed two alternate, dichotomous keys to distinguish the three genera *Rotala*, *Ammannia* and *Nesaea*.

TABLE 3

(*Nomenclature and distribution of the thirty species under study*)

1. *Rotala mexicana* Cham. & Schlecht. in Linnaea 5 : 567 (1830); Koehne, in Engl., Pflanzenr. 17 (4, 216) : 29 (1903).
   Type: Mexico, Hacienda de la Laguna, Oct., *Schiede et Deppe* s. n. (not seen).
   Distribution: Tropical South America and West Tropical South America, West Indies, Tropical Africa (Nigeria, Angola and East Cameroons), Madagascar, India (Bombay and Bihar), China, Japan, Korea, Philippines, Java, New Guinea and Australia.
2. *Rotala verticillaris* L., Mant. Pl. Alter. Specier. ed. 2 : 175 (1771) pro parte, Koehne, l.c. : 30 (1903).
   Type: "in India orientali" (LINN 52/1).
   Distribution: South India, Sri Lanka, Japan, New Zealand (?) and Central Africa.
3. *Rotala myriophylloides* Welw. ex Hiern, in Oliver, Fl. Trop. Africa 2: 469 (1871); Koehne, l.c. : 31 (1903).
   Type: Lower Guinea, Angola, Huilla, 5,500, May 1860, *Welwitsch* 2348 (BM, holotype).
   Distribution: Africa (Angola, Zambia, Rhodesia, Zaire and South Africa).
4. *Rotala ramosior* (L.) Koehne, Fl. Brazil 13(2) : 194, t. 39, fig. 1 (1877), et l.c. : 32 (1903).
   Ammannia ramosior L., Sp. Pl. ed. 1 : 120 (1753).
   Type: "in Virginia", *Gronovius* (LINN 156/2).
   Distribution: United States of America, Central America, Tropical South America and West Tropical South America, and West Indies.
5. *Rotala serpiculoides* Welw. ex Hiern, in Oliver, Fl. Trop. Africa 2 : 469 (1871); Koehne, in Engl., Pflanzenr. 17 (4, 216) : 33 (1903).
   Type: Lower Guinea, Angola Huilla, 3,800-5,500', (ad 5000 ped,) Apr. 1860, *Welwitsch* 2355 (BM, holotype).
   Distribution: Africa (Sudan, Uganda, Kenya, Tanzania, Zaire, Zambia, Angola).
6. *Rotala pentandra* (Roxb.) Blatt. & Hallb. in Journ. Bombay Nat. Hist. Soc. 25 : 707 (1918), pro parte; Leeuwen in *Blumea* 19 : 55 (1971).
   Ammannia pentandra Roxb., Fl. Ind. 1 : 448 (1820).
   Type : India (Roxb. Icon. 548, CAL, K).
   Rotala leptopetala (Bl.) Koehne in Engl. Bot. Jahrb. 1 : 162 (1880) et l.c.: 34 (1903).
   Ammannia leptopetala Bl., Mus. Bot. Lugd. Bat. 2 : 134 (1856).
   Type: "in oryxetis inundatis, Javae", *Blume* s.n. (L, not seen).
   Distribution: India, Sri Lanka, South-East Asia, Japan, China and Hong Kong.
7. *Rotala diandra* (F. v. Muell.) Koehne in Engl. Bot. Jahrb. 1 : 169 (1880) et l.c. : 39 (1903).
   Ameletia diandra F. v. Muell., Fragm. Phyt., Austr. 3 : 108 (1862), et in Syst. Arrangement of the plants of the gulf of Carpentaria : 81 (1882).
   Type: Circum lacunas nec non secus ripas humidas depressas fluviorum Victoriae et Fitzmaurice River, sicut ad rivos iisdem tributarios frequens", anonymous s.n.
   Distribution: North Australia.
8. *Rotala tenella* (Guill. et Perr.) Hiern, in Oliver, Fl.

Trop. Africa 2 : 467 (1871); Koehne, in Engl., Pflanzenr. 17 (4, 216): 39 (1903).

Ammannia tenella Guill. et Perr., Fl. Seneg. Tent. 1 : 297 (1833).

Type: Senegal: "Walo, prope Richard-Tol, la Senegalaise etc."

Distribution: Africa (South Africa, Zaire, Cameroons, Uganda, Tanzania, Kenya, Ghana, Nigeria, Sierra Leone, Mali).

9. *Rotala serpyllifolia* (Roth) Brem. in Acta Bot. Neerl. 3 : 149 (1954). *Micranthus serpyllifolius* Roth, Nov. Pl. Sp : 282 (1821).

Rotala tenuis (Wight) Koehne, in Engl. Bot. Jahrb. 1 : 177 (1880) et l.c. : 42 (1903).

Ameletia tenuis Wight, Icon. Pl. Ind. 1 : 6. t. 257B (1840).

Type: India (not indicated precisely); I select t. 257B as lectotype).

Distribution: India (Bihar, South India, Madhya Pradesh and Panjab) and Pakistan (Sind).

10. *Rotala congolensis* Fernandes & Diniz in Bol. Soc. Brot. Ser. 2, 29 : 89 (1955).

Type: "Habitat in Congo Belgica, loco dicto Keyberg pr. Elisabethville, May 1948, *A. Schmitz* 1684 (COI, typus)".

Distribution: Africa (Zaire, Rhodesia).

11. *Hionanthera garciae* Fernandes & Diniz in Bol. Soc. Brot. Ser. 2, 29 : 94 (1955).

Type: Habitat in Mosambique, Manica and Sofala distr., Serra de Bandula pr., Chimoio, 28 Mar. 1948, *Garcia* 790 (LISC, holotype; K, isotype).

Distribution: Africa (Mozambique).

12. *Ammannia multiflora* Roxb., Fl. Ind. ed. Carey 1 : 447 (1820); Koehne, in Engl., Pflanzenr. 17 (4, 216) : 48 (1903).

Syntypes: India : "a native of open lands about Calcutta......" *Roxburgh* s. n. (K); East India, *Roxburgh* s.n. (K,). (See also Roxb. Icon. 915, CAL, K).

Distribution: Asia (Iraq, Soviet, Central Asia, China, Japan, India, Malaya, Java), Australia (West and Central) and Africa (Angola, Tanzania, South Africa, Socotra) and Madagascar.

13. *Ammannia octandra* L. f., Suppl. Plant 8 : 127 (1781); Koehne, l.c. : 50 (1903), *non* Cham. & Schlecht. (1827).

Type: India: "Habitat in India Orientali, *Koenig*" (LINN 156/5).

Distribution: South India, Sri Lanka, China, Java, Philippines, [(introduced to Europe (unlocalised) BM).]

14. *Ammannia coccinia* Rottb., Pl. Hort. Univ. Havn. Prog. descr. : 7 (1773); Koehne, l.c. : 49 (1903).

Type: Not known.

Distribution: United States of America, Central America, West Indies, Tropical South America, Guam, the Marian Islands, [(introduced to Portugal, Iraq and (?) Philippines)].

15. *Ammannia latifolia* L., Sp. Pl. ed. 1 : 119 (1753); Koehne l.c. 4 : 50 (1903).

Type: West Indies: "Habitat in Caribaeis, locis humidis" (LINN 156/1).

Distribution: United States of America, West Indies and Tropical South America [(introduced to Europe? (unlocalised) BM)].

16. *Ammannia verticillata* (Arduino) Lam., Encycl. 1 : 131 (1753), pro parte; Koehne, l.c. : 51 (1903).

Cornelia verticillata Arduino, Animadv. Botan. Spec. alter. 2 : 9, t.l. (1763).

Type: Italy: Venetian region, "Dominicio Vandellio" (VICENZA MUS., not seen).

Distribution: Europe, Asia (Iraq. South India, Iran), Africa (Egypt).

17. *Ammannia senegalensis* Lam., Illustr. 1 : 311 (no. 1553, tab. 77, f. 2 (mediocris) (1791); Koehne, l.c. : 52 (1903).

Type: "E. Senegal", *Roussillon* s. n. (P. microfiche no. 238/18, K).

Distribution: Africa (Senegal, Sierra Leone, Nigeria, Chad, Ghana, Angola, Mali, Egypt, Sudan, Zambia, Tanzania, South Africa), Madagascar, (?) China and Hong Kong.

18. *Ammannia baccifera* L., Sp. Pl. ed. 1 : 120 (1753); Koehne, l.c. : 53 (1903).

Type: "Habitat in China, *Osbeck* (LINN 156/3, 4),

Distribution: Asia (China, India, Sri Lanka, Malaya, Papua, Java, Vietnam, Celebes, New Guinea, Afghanistan, Iran, Iraq, Arabia), Australia, Africa (Egypt, Sudan, Uganda, Zaire, Tanzania, Rhodesia, Angola, Cameroons, South Africa, Socotra, Mali, Nigeria, Ghana, Malawi, Mozambinque), Madagascar and West Indies.

19. *Ammannia dichotoma* (BL.) S. G. Panigrahi, comb. nov. *Cryptotheca dichotoma* Bl. Bijdr. Fl. Nederl. Ind. pt. 11 : 1129 (1826).

Type: Java, Timor, *Blume* (L, not seen).

Ammannia microcarpa sensu Koehne, l.c. : 55 (1903), pro parte, quoad synon, excl. typum, *non* DC. (1828).

Distribution: Java, Timor, Celebes.

20. *Nesaea crassicaulis* (Guill. & Perr.) Koehne in Engl. Bot. Jahrb. 3 : 324 (1882), et l.c. : 225 (1903).

Ammannia crassicaulis Guill. & Perr., Fl. Seneg. 1 : 303 (1833).

Type: Senegal: "Circa *Khann* in Penins. Promontorii-Viridis: ad fontes *Ghielcouil*, in regno Cayor".

Distribution: Africa (Rhodesia, Zambia, Angola, Zanzibar, Tanzania, Uganda, Kenya, Zaire, Cameroon, South Africa, Mozambique, Chari, Portuguese Guinea) and Madagascar.

21. *Nesaea lanceolata* (Heyne ex Clarke) Koehne, l.c. : 325 (1882), et l.c. 226 (1903).

Ammannia lanceolata Heyne ex Clarke in Hook. f., Fl. Brit. Ind. 2 : 570 (1879).

Syntype: Ceylon, *Thwaites* 2796 (BM, selected here by me as lectotype).

Distribution: India (South, Sri Lanka and Australia.

22. *Nesaea sarcophylla* (Welw. ex Hiern) Koehne : 328 (1882), et l.c. : 228 (1903).

Ammannia sarcophylla Welw. ex Hiern in Oliver, Fl. Trop. Africa 2 : 479 (1871).

Type: Lower Guinea (Angola); Dist. Mossamedes July 1859, *Welwitsch* 2365 (BM, holotype).

Distribution: Africa (Angola, Tanzania).

23. *Nesaea triflora* (Linn. f.) Kunth in H. B. K., Nov. Gen. et Sp. Pl. 6 : 191 (1824); Koehne, l.c. : 330 (1882), et l.c. : 230 (1903).

Lythrum triflorum Linn. f., Suppl. : 249 (1781).

Type: Mauritius (sphalm. 'Habitat in America' (not in LINN).

Distribution: Africa (Cameroon) and Madagascar; Mauritius, Reunion, Sri Lanka and India.

24. *Nesaea floribunda* Sond. in Harv. & Sond., Fl. Cap. 2 : 517 (1861/62); Koehne, in l. c. 231 (1903).

Type: South Africa: Habitat, on the Omblas river, near Port Natal, Apr. *Drege*, s. n. (S, D).

Distribution: Africa (Tropical), Angola, South Africa, Tanzania, Zambia, Uganda, Kenya, Rhodesia.

25. *Nesaea cordata* Hiern in Oliver, Fl. Trop. Afr. 2 : 475 (1871); Koehne l.c. : 232 (1903).

Syntypes: Angola, Pungo Andongo, 2400-3800', *Welwitsch* (2327) (selected by me here as lectotype).

Distribution: Africa (Rhodesia, Mozambique Angola, Tanzania, Malawi, Zanzibar, South Africa).

26. *Nesaea tolypobotrys* Koehne in Engl. Bot. Jahrb. 22 : 151 (1895), et in l.c. 232 (1903).
Type: Natal auf Wiesen in Fluss Umhlatu aan December, *Wood* 334 (BM, holotype).
Distribution: South Africa (Natal, Mozambique).

27. *Nesaea dodecandra* (DC.) Koehne in Engl. Bot. Jahrb. 3: 334 (1882) et in l.c. : 234 (1903).
Ammannia dodecandra DC. in Mem. Soc. Phys. Geneve 3(2) 89, t. 2 (1826).
Type: Senegal, Roger debit, Major 1825, *Perrottet* 29(K).
Distribution : Africa (Senegambia, Ethiopia, Sudan, Senegal).

28. *Nesaea heptamera* Hiern. in Oliver. Fl. Trop. Africa 2 : 472 (1871), et Koehne in l.c. : 235 (1903).
Type: "Mosambique, dist. Zambia and Lake Shirwa, *Mellesr* s.n." (Zamba and east end of Lake Shirwa, *C. J. Meller*) (K).
Distribution: Africa Mozambique, Sudan, Zambia, Kenya, Tanzania, Malawi and Rhodesia).

29. *Nesaea lythroides* Welw . ex Hiern in Oliver, Fl. Trop. Africa 2 : 471 (1871); Koehne l.c. : 237 (1903).
Type: Lower Guinea Angola, Mossamedes littoral, *Welwitsch* s.n. 2334. (BM, holotype).
Distribution: Africa (West Africa-Mossamedes, Uganda, Kenya, Tanzania).

30. *Nesaea sagittifolia* (Sond.) Koehne in Engl. Bot. Jahrb. 3 : 339 (1882), et l.c. : 240 (1903).
Lythrum sagittaefolium Sonder in Linnaea 23 : 41 (1850).
Type: "In Sumpfe beim Magalisberg", *Zeyher* 543 (BM, holotype, K, isotype).
Distribution: South Africa (Natal, Transvaal).

Accepting Koehne's (1903) treatment of the three genera *Rotala* L., *Ammannia* L. and *Nesaea* Comm. ex Kunth together with *Hionanthera* Fernandes & Diniz as a basis for study, I have carried out a comparative study of relevant literature together with a large number of specimens deposited in the Kew herbarium (K) from the distributional range of the four genera. The account which follows sets out the taxonomy, provides detailed morphological descriptions and brief notes on ecology and distribution of the four genera in the world flora. From among the 137 species referred to these genera in modern floras, I selected 30 species (Table 3) to ascertain how far the gross morphological features characteristic of these genera and infra-generic categories find support from anatomy of their stems (Fig. 1) and leaves (Panigrahi, S. G. 1975), vasculature of the inflorescences (Panigrahi S. G. & Panigrahi G. 1977), palynology (Panigrahi, S. G. 1978a) and scanning electron microscopy of their seeds etc. (Panigrahi, S. G. 1978b). These studies have enabled me to lay down a more comprehensive basis for generic recognition, as formulated in the key below:

KEY TO THE FOUR GENERA—A SYNTHESIS OF CHARACTERS

1. Pseudocolpi absent or if present, 3 in number, pollen grains always minutae; inflorescences of various types:

  2. Aerenchyma of type 'A', leaf isobilateral or centric, never conduplicate; primary phloem fibres absent in stem except in *R. tenuis*, cortex/xylem ratio varies between 0.312:1 and 16.235:1; flowers solitary, axillary; inflorescences monotelic, polytelic or frondose types, never in glomerules; sexine striations granular, reticulate or granular reticulate; pseudocolpi when present, 3 in number; seeds small, 506 x 342 μm, (cells on the outer surface of the testa when dry with a bulging over the entire length but when wet, the epidermis cracking and releasing mucilaginous hairs (short and smooth in *Rotala verticillaris*) but long and variously rugged in other species) as seen in SEM ... *Rotala*

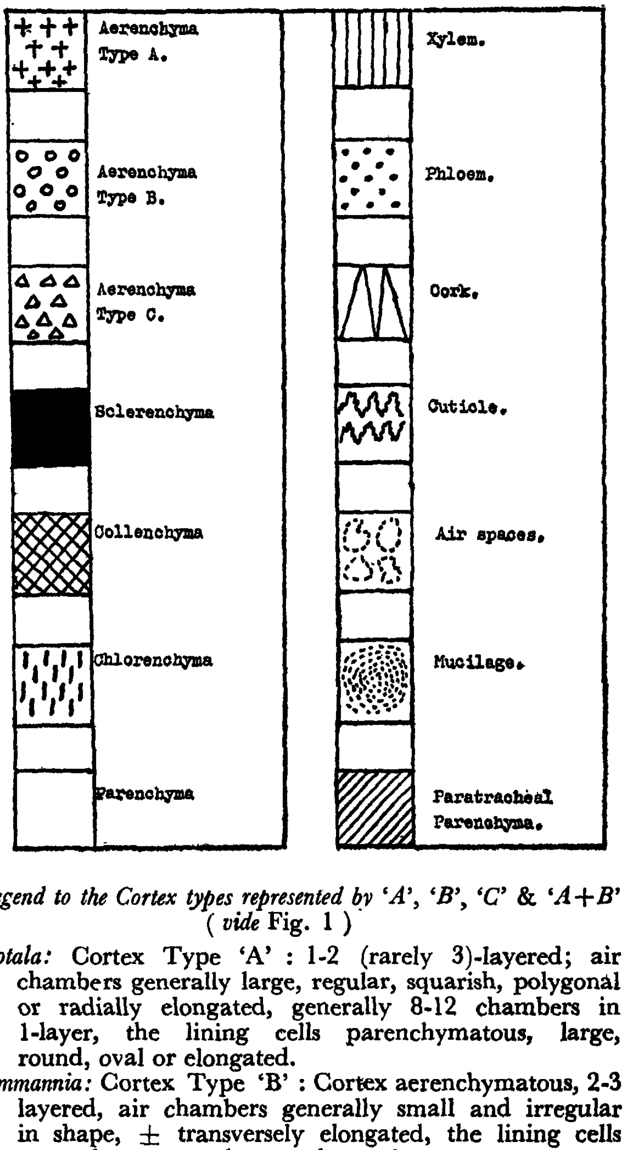
  2. Aerenchyma of type 'A' + 'B'; leaf isobilateral and conduplicate and erect; cortex/xylem ratio 2.2:1; inflorescence monotelic forming a glomerule; sexine striations transverse, thick and straight; pseudocolpi absent; seeds large, (1480 μm long × 930 μm broad); (cells on the outer surface of the testa when dry ± bulging outwards at one end but when moistened releasing mucilage hairs of two types, smooth and tuberculate as seen in SEM of seeds) ... *Hionanthera garciae*

1. Pseudocolpi present and six in number; grains minutae or mediae; inflorescences of monotelic type; never frondose or polytelic:

  3. Aerenchyma of type 'B'; xylem vessels with long tails; cortex/xylem ratio always less than 1; sexine striated, striations long and thick (granular in *Ammannia dichotoma* only); testa when dry with ± vertically orientated rows of long rectangular cells on the outer convex surface, lower surface flat or concave but without a distinct surrounding rim of over-arching tissue, (mucilaginous hairs released by the epidermis when wet terete, smooth or tuberculate,

the etchings on the wall of the lumen, if present, not distinctly seen in SEM of *A. latifolia* seeds) ... *Ammannia*

3. Aerenchyma of type 'C'; xylem vessels without or with short tails; cortex/xylem ratio varies between 1.15:1 and 7.5:1; sexine striated, reticulate or granular, striations when present short, thin and interrupted; testa with ± regular transverse rows of short, rectangular or rounded cells on the outer convex surface, when dry the lower surface deeply concave with overarching surrounding rim of upper testa (mucilaginous hairs released by the epidermis when wet with rounded (pitcherlike) base, irregularly-striated stalk showing visible folds and furrows with ± regular rounded etchings of the wall of the lumen seen in SEM of *Nesaea triflora* seeds) ... *Nesaea*



Legend to the Cortex types represented by 'A', 'B', 'C' & 'A+B' (*vide* Fig. 1)

Rotala: Cortex Type 'A' : 1-2 (rarely 3)-layered; air chambers generally large, regular, squarish, polygonal or radially elongated, generally 8-12 chambers in 1-layer, the lining cells parenchymatous, large, round, oval or elongated.

Ammannia: Cortex Type 'B' : Cortex aerenchymatous, 2-3 layered, air chambers generally small and irregular in shape, ± transversely elongated, the lining cells parenchymatous, short and angular.

Nesaea: Cortex Type 'C' : Cortex aerenchymatous, 3-5 layered, air-chambers large and small, irregularly shaped, radially elongated; the lining cells parenchymatous or collenchymatous, round, elongated or polygonal and of different sizes.

Hionanthera: Cortex type 'A + B': Cortex aerenchymatous, made up of two distinct bands, the outer band narrower than the inner one and consisting of 2-3 layers of irregular, transversely elongated air spaces of various shapes; but large and elongated in the inner layers; the inner band made up of the lining cells parenchymatous, small and angular in the outer layers, one layer of square, radically elongated air chambers.

TAXONOMY OF THE FOUR GENERA

Rotala L., Mantissa Plantarum Altera, ed. 10: 143 (1771).

Type species: *R. verticillaris* L., Mant. Pl. Alter-specier. ed. 2: 175 (1771).

Type: in "India Orientali" (LINN 52/1). (Named from the latin word meaning wheel, referring to the whorled leaves of some species; see Britton & Brown, 1913: 579).

Annual, more rarely perennial glabrous herbs; floating, creeping or ascending. *Stem* four-angled or terete; filiform or thick. *Leaves* sessile or subsessile, opposite, decussate, verticillate or rarely alternate; linear, oblanceolate, ovate; attenuate to the base, membranous. *Inflorescences* various; Frondose, Monotelic or Polytylic (Troll. 1964, 1969) (solitary flowers or few together, in spikes or rarely in umbels or in terminal spikes). *Flowers* sessile or subsessile, actinomorphic, 3-6-merous, seldom dimorphic; bracteoles 2, opposite, at the base of the calyx tube; rarely absent. *Calyx tube* campanulate, globose, tubular, urceolate; scarious, corolline or rarely herbaceous; 2.5-5 mm long. *Calyx lobes* (3-) 4-(-6), acute to acuminate, often subulate; sinuses appendaged, appendages shorter or longer than lobes or absent; a nectariferous ring present at the base of the calyx tube. *Corolla* with 0-4-6 petals, white or pink, caducous, rarely persistent; small, hardly exceeding the calyx lobes. *Stamens* 4-6, episepalous, inserted or exserted. *Ovary* sessile or subsessile, absence of the disc at the proximal end, incompletely (3-) 4 or (-6) locular, the upper portion of each septum ±

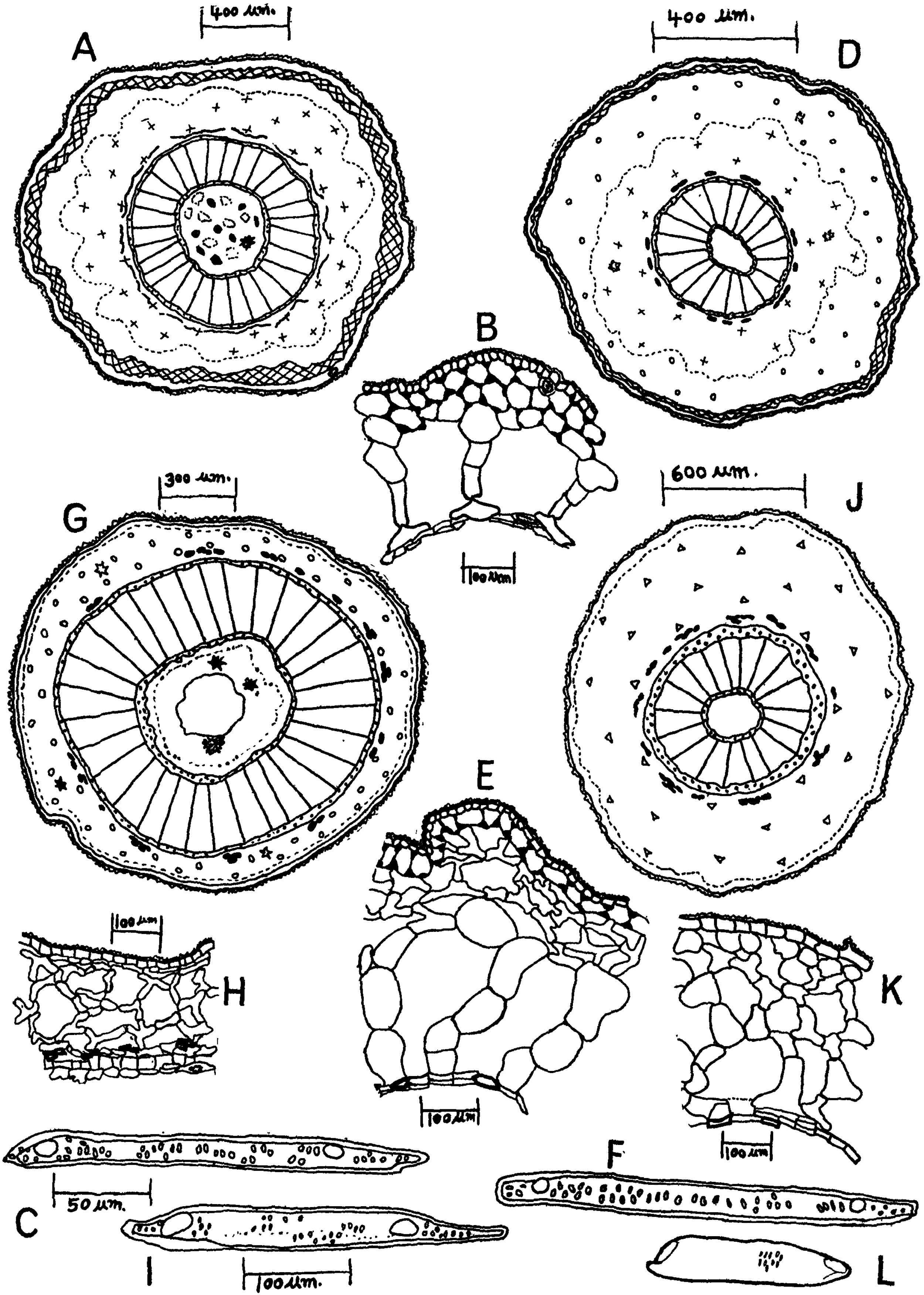


Fig. 1

A, B, C—*Rotala verticillaris*. D, E, F—*Hionanthera garciae*. G, H, I—*Ammannia latifolia*. J, K, L—*Nesaea triflora*
A, D, G, J—T. S. Stem (diagramatic). B, E, H, K—Aerenchyma of Types 'A', 'A+B', 'B' & 'C' respectively.

incomplete; style columnar, short or wanting; stigma capitate; placenta ± central, compressed, free at the top. *Capsule* membranaceous, usually exceeding the calyx, cartilaginous, septicidally dehiscent, 2-4 valved; dense to faint transverse striations on the outer wall (Plate I: 2); one valve of the capsule when dehisced is crowned with the persistent style. *Seeds* minute, numerous or few, ovoid or ellipsoid, hemispheric or plano-convex, polymorphic: triangular-ovoid, ellipsoid, tetrahedral, compressed-hemispheric with convex outer surface and compressed of flat inner surface; 461 (506)-545 μ m in length and 313 (348)-389 μ m in breadth.

Distribution: 56 species, common in hot or warm parts, aquatic or amphibious; many species are found as weeds in rice fields and irrigation channels.

ASIA: 21 spp. (17 endemic); AFRICA and MADAGASCAR: 18 spp. (16 endemic); AUSTRALIA: 5 spp. (2 endemic) and AMERICA: 3 spp. (1 endemic).

Hionanthera A. Fernandes & M. A. Diniz, Bot. Soc. Brot. Ser. 2, 29: 90 (1955).

Type species: *H. mossambicensis* Fernandes & Diniz, l.c.

Type: Mozambique, Nampula, 7 Nov. 1936, *Torre* 719 (COI, holotype; LISC, isotype not seen).

Annual or perennial, glabrous in aquatic or marshy places. *Stem* tetragonal, up to 1 m high. *Leaves* decussate, sessile, linear, dilated at the base, conduplicate and finely pointed at the apex, median nerve extended to a fine point. *Inflorescences* MONOTELIC (sessile, subsessile, dichasium or glomerule with many flowers); bracteoles 2, opposite. *Flowers* typically 4-merous, sometimes 3-5-merous. *Calyx tube* campanulate; dry, scarious or corolla-like at the lower part, upper part with 4-lined structure; appendages short; minute ring or nectaries are located at the base. *Corolla* with petals persistent, corrugated in bud; stamens 4 or 3-5, episepalous. *Ovary* sessile or subsessile, incompletely bilocular, 2-5 ovulate, placenta not continuous with the style, the latter long; stigma linear to swollen. *Capsule* membranaceous, narrow, irregularly dehiscent. *Seeds* equal to the number of ovules or less, large, dark-coloured, 1460 (1480)-1500 μ m long × 920 (930)-940 μ m broad.

Distribution: 4 spp. endemic to Africa (Mozambique).

Ammannia [Houst.] L., Sp. Pl. 1: 119 (1753) pro parte; Gen. Pl. ed. 5: 55 (1754).

Lectotype species: *Ammannia latifolia* L., *ibid.*: 119. (Selected by Britton & Brown, 1913: 577).

Type: Caribbean [LINN. 156/1].

The genus is named in honour of Johann Amman, a German botanist 1699-1741.

Annual, rarely biennial or perennial, glabrous or glabrate herbs, up to 1 m high; in aquatic or marshy or in xerophytic habitats. *Stem* herbaceous or slightly woody at base; mostly 4-angled, (erect, branching only from the base in aquatic spp.). *Leaves* sessile or subsessile, decussate, rarely alternate, linear, lanceolate or oblong; auriculate or cordate at base. *Inflorescences* MONOTELIC (of axillary cymes with 1-15 flowers at the node). *Flowers* sessile or peduncled, actinomorphic, 4-5 merous; 2 linear small opposite bracteoles at the base of the calyx tube. *Calyx tube* campanulate, urceolate, becoming globose in fruit, 1.5-6 mm long, greenish to rose-coloured, eight-nerved with 4 nerves specially prominent at anthesis. *Calyx lobes* 4(-5), short and broad, four-angled and four-toothed, often with small appendages in the sinuses, appendages thick, short or equalling the calyx lobes or absent. *Corolla* with petals 0-4 (-5), small, pink, rose-coloured, violet, purplish, white or yellow, caducous, not crumpled in bud. *Stamens* 4-8, included or exserted, slender, long or short. *Ovary* (2-) 4 (-5) locular; arises from near the base of the calyx tube; slender with or without a disc at the base, enclosed in the calyx tube; upper portion of the septa ± incomplete, placenta not continuous with the style; style filiform, longer than the ovary and exserted or thick, shorter than the ovary and included; stigma capitate. *Capsule* globose or ellipsoidal, membranous and included in the calyx tube or exceeding the calyx, irregularly dehiscent; outer wall smooth, cells polygonal without transverse striations (as in *Nesaea*, Plate I: 1). *Seeds* polymorphic: minute, numerous, ovoid, roundish or triangular in outline, often concave on one side;. 436 (511)-560 μm long × 307 (351)-390 μm broad.

Distribution: 30 species; in damp places in the tropics of both the hemispheres; most species grow in wet regions; some species are extra-tropical and extend to xerophytic climates.

ASIA: 7 spp. (2 endemic); AFRICA: 13 spp. (10 endemic); AUSTRALIA: 3 spp. (none endemic); AMERICA: 5 spp. (3 endemic); EUROPE: 2 spp. (introduced).

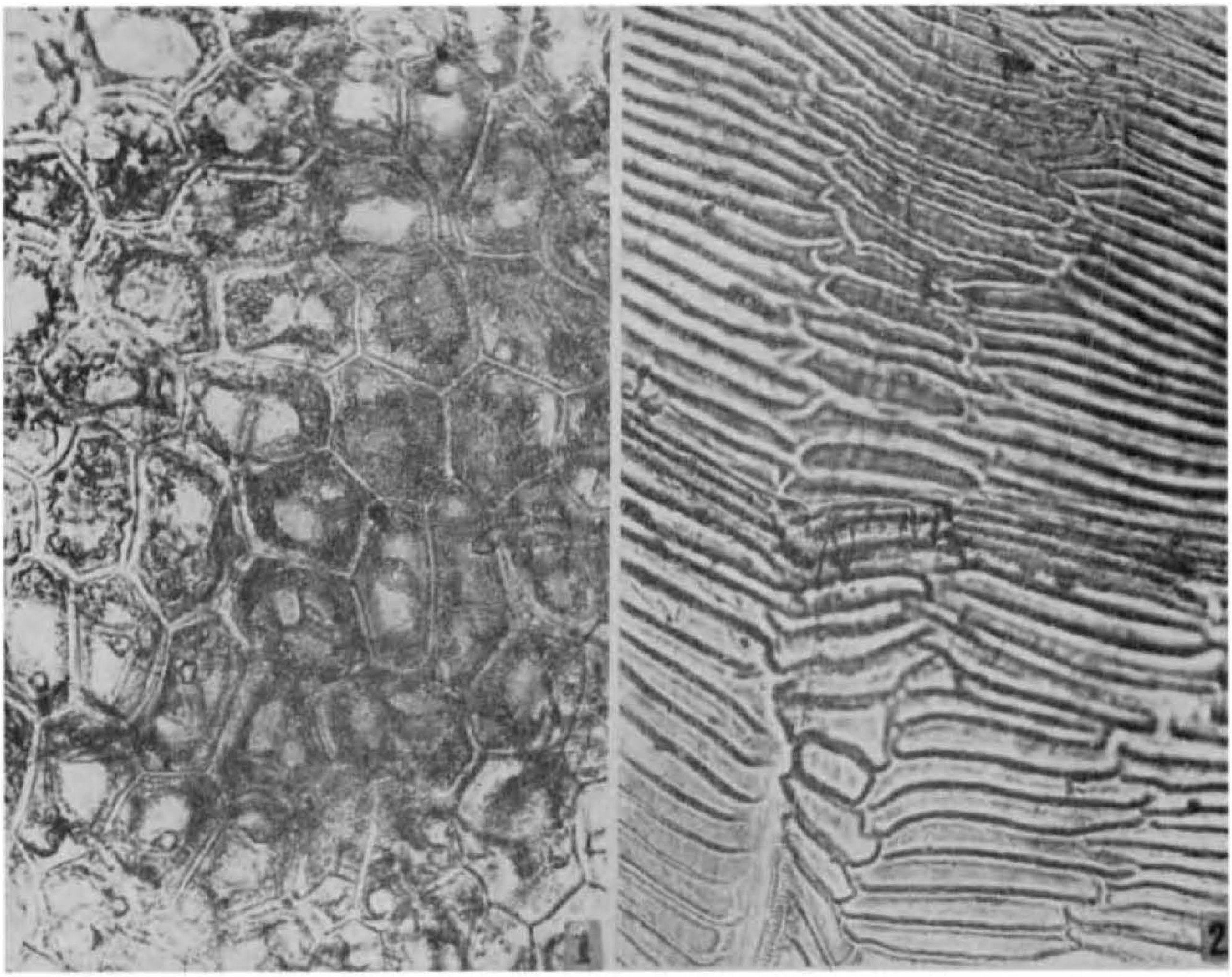


Plate I: Figs. 1-2: 1. *Nesaea triflora*: Capsule wall with polygonal or isodiametric cells—evenly thickened (× 500) 2. *Rotala myriophylloides*: Capsule wall with thick horizontal striations characteristic of the genus *Rotala* (× 500)

Nesaea Comm. ex [Juss., Gen. Pl.: 332. 1789, et l.c.: 368 (1791 nom. nud.)] Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 6: 191 (1824).

Type species: *Nesaea triflorum* (L. f.) Kunth l.c.

Type: Mauritius (not America) (not seen).

(*Nesaea* in Greek means 'insula' which in turn means 'island'.).

Annual or perennial herbs, under-shrubs or rarely shrubs; glabrous, rarely pubescent. *Stem* terete or tetragonal. *Leaves* sessile or subsessile; opposite, alternate or whorled. *Inflorescences* MONOTELIC (of solitary flowers or in dichasial cymes, glomerules or in capitula; axillary or terminal). *Flowers* actinomorphic, sometimes dimorphic. *Calyx tube* campanulate, urceolate or subglobose; herbaceous, persistent. *Calyx lobes* 4-8; appendages short or long or absent. *Corolla* with petals 0-8, corrugated in bud, caducous, short or long, as many as the calyx lobes, usually coloured, ovate or obovate, inserted in the calyx tube, alternate with the sepals. *Stamens* 4-23, usually twice as many as or three times or equalling the number of calyx lobes; episepalous or epipetalous, usually all or half of them exserted, uni-or bi-seriate. *Ovary* sessile, 2-5-celled, ovoid, glabrous and included; placenta thick, usually lobed, central septum running up to the style; style 0, short or long; stigma capitate or dot-like; ovules many. *Capsule* membranous or thick, included or exserted; globose or ellipsoidal, cells polygonal as in *Ammannia* (Plate I: 1); operculum dehiscent at the top and irregular or sub-septifrugal-dehiscent on the lower part; valves remaining as wings. *Seeds* polymorphic: numerous, minute, flattened or hollowed on one side and round or convex on the outer side; 458 (517)-568 μ m long × 364 (415)-462 μ m broad.

Distribution: 56 species, growing on wet soils; most species are terrestrial, a few are found in regularly inundated regions; *N. cordata* Hiern and *N. crassicaulis* (Guill & Perr.) Koehne are found as weeds in drainage, ditches and rice fields (Cooke *et al.* 1974).

Africa and Madagascar: 46 spp. (45 endemic); Australia: 3 spp. (1 endemic); India: 3 spp. (1 endemic); U.S.A. and Mexico: 3 spp. (2 endemic).

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